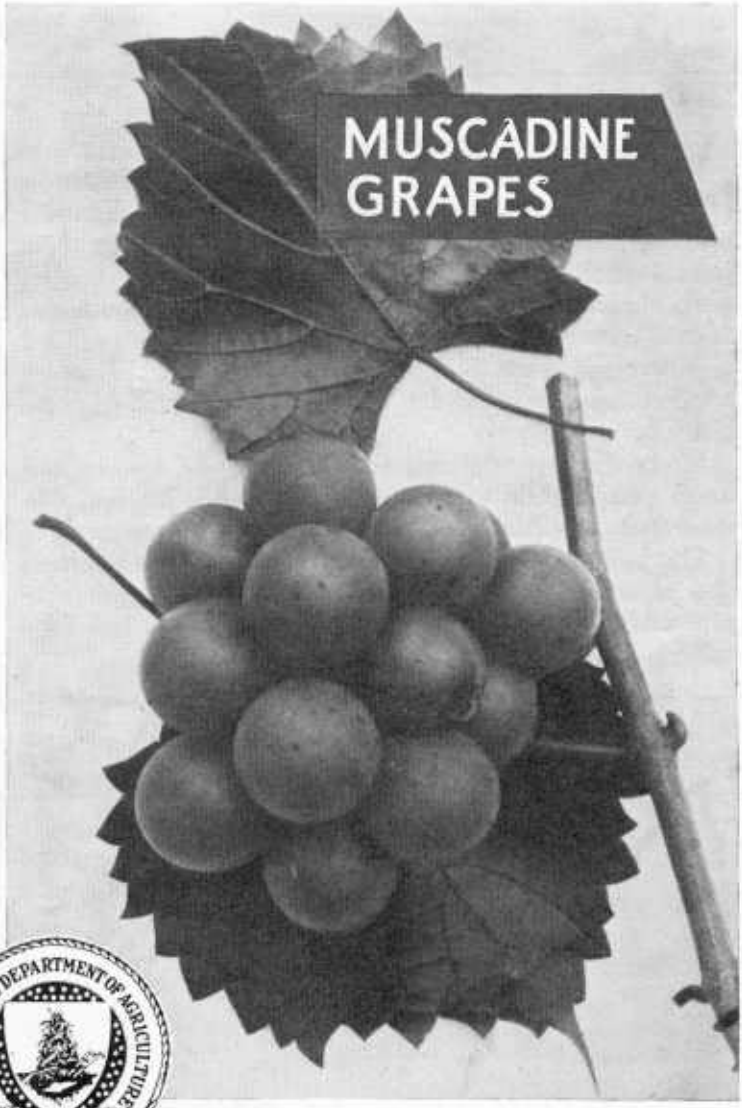
U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1785



MUSCADINE GRAPES are indigenous to the southeastern section of the United States, where they grow in greater or less profusion in the wild state. Through careful selection from the wild grapes and scientific breeding there have been developed a considerable number of varieties particularly adapted to the home needs in the Southeast, both as table grapes and as raw material for a variety of food and beverage products. Not being resistant to low winter temperatures they do not thrive in the northern grape districts.

Muscadines are relatively resistant to grape diseases and insect pests and do well with a minimum of care, but, like most fruits, respond favorably to good cultural treatment.

This bulletin sets forth in nontechnical form the information accumulated by the Department over a considerable period of years on muscadine grape varieties, their breeding, culture, and uses.

Washington, D. C. Issued January 1938

MUSCADINE GRAPES

By CHARLES DEARING, *associate horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry*

CONTENTS

	Page		Page
Introduction	1	Harvesting and handling	29
Propagation	6	Yields	29
Seeds	6	Uses of muscadine grapes	31
Cuttings	6	Insect enemies and diseases	32
Layering	9	Varieties	32
Grafting	9	Scuppernong	32
Soils	9	Mish	35
Planting	10	James	35
Soil management	13	Flowers	35
Fertilization	16	Thomas	35
Pollination	16	Eden	36
Training and pruning	19	Other varieties	36
Trellis construction	28		

INTRODUCTION

MUSCADINE GRAPES are native to the southeastern coastal plain area of the United States. They thrive in most of the soils of this area, which extends from Virginia to Florida and along the Gulf coast to Texas. The distribution of the species extends also northward along the Mississippi River to Missouri and reaches well up into the Blue Ridge Mountains along the southeastern seaboard (fig. 1).

In most of the muscadine grape area (fig. 1) the temperature rarely goes lower than 10° F. and practically never goes to zero. Occasionally vines are found growing beyond these temperature limits, but in such cases they are more or less protected or are not thriving. The minimum temperature that the vines can stand depends largely upon the preceding weather. While vines have been known to live through periods in which the thermometer has registered as low as −10°, they may be damaged at much higher temperatures if the preceding weather has been warm and the change in temperature comes suddenly. Native vines at the northern limits of their range and in the higher altitudes, such as western North Carolina, will stand considerably lower temperatures than vines in the southern coastal area. Our present muscadine varieties are likely to be killed where temperatures as low as 0° occur and may be injured at somewhat higher temperatures.

Within this territory the muscadines are hardy and have been more extensively grown for many years than other grapes. Although during the prohibition period the culture of these grapes in large vineyards practically ceased, interest in them revived with the legalization of wine manufacture. Many small vineyards have been started in this territory, and a number of larger projects are being

developed. The grapes were extensively used in the past for wine making, but they are also highly prized as fresh fruit by the people of the Southeast, and can be made into excellent unfermented grape juice and other culinary products.

The muscadine grapes, which include two botanical species (*Vitis rotundifolia* Michx. and *V. munsoniana* Simpson ex Munson), make up one of the two groups of the genus *Vitis*. The muscadines are sometimes called "berry grapes" because of the tendency of the individual berries of many varieties to shell from the cluster as soon as ripe instead of adhering, as do varieties of the other group (euvitis, often called "bunch grapes"). Although the berries of most muscadine varieties tend to shell, fruit of some of the varieties adhere to the cluster as tenaciously as do the so-called bunch grapes.

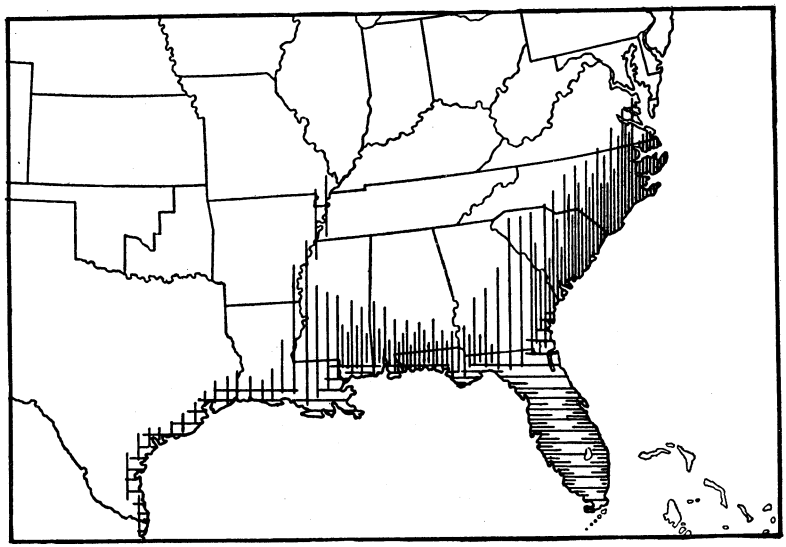


FIGURE 1.—Sketch map of the southeastern portion of the United States, showing the natural distribution of muscadine grapes. The vertical lines show the region where the rotundifolia varieties grow and the horizontal lines the growing region of the munsoniana varieties.

The muscadines have hard wood, varying in color from ashy gray to grayish brown or sometimes yellowish brown. While the bark adheres closely on the young branches, it sheds annually on the older wood, especially on the trunks of vigorously growing vines. Several trunks may develop if a vine is not trained when young (fig. 2). In the young canes the pith is continuous through the nodes. The young wood is covered with numerous small, prominent, warty lenticels. The growing shoots are yellowish or reddish at the tip when young, are short-jointed, angled, or sometimes flattened, and have intermittent, relatively long, tough, strong unforked single tendrils of the same color as the twig on which they belong. The tendrils, when permitted to do so, may girdle even large branches. The leaves (figs. 3 and 4) are below medium size, smooth and shiny above and underneath, more or less round to broadly cordate with a wide, rather shallow basal sinus, and generally not lobed, though sometimes slightly three-lobed. The margins of the leaves are prominently toothed.

FIGURE 2.—Trunk of an old rotundifolia vine.

The fruit clusters are more or less roundish, ranging from loose to compact, and are relatively small, consisting of from 1 to 40 berries, generally from 4 to 10. The berries are round and range from very small to very large. They are green, pearly, bronze, red, or black and usually are more or less speckled with red or russet dots. The skin is relatively thick and tough, sometimes giving the impression of leatheriness; the pulp varies from meaty to melting and juicy. The

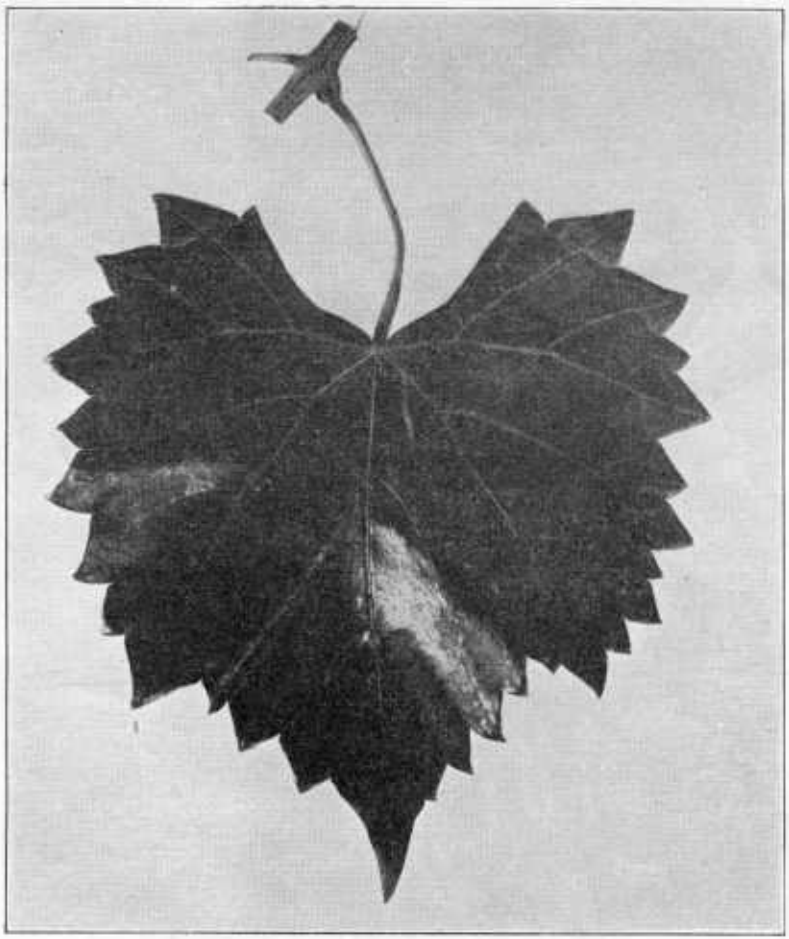


FIGURE 3.—A Scuppernong leaf (two-thirds natural size).

seeds (fig. 5) are two to four in number, occasionally one, five, or six, and vary with the variety from small to very large in size. They are flattened, shallow, broad, notched, with very short pointed beak and narrow raphe and chalaza, surrounded by radiating wrinkles. In almost all fruiting varieties the pollen is practically sterile or entirely so. The muscadine vines are late in leafing out and flowering in the spring, and the fruit of most varieties is late in maturing.

Of the two species of muscadine grapes, *Vitis rotundifolia* is the more important. All the prominent horticultural varieties belong to it, and the species is native throughout all the muscadine area except the extreme South. *V. munsoniana*, on the other hand, is more like a subtropical variation and is native only in Florida, on the borders of the Gulf of Mexico, and near the southeastern Georgia coast. *V. rotundifolia* (fig. 6) bears small clusters of large berries with large

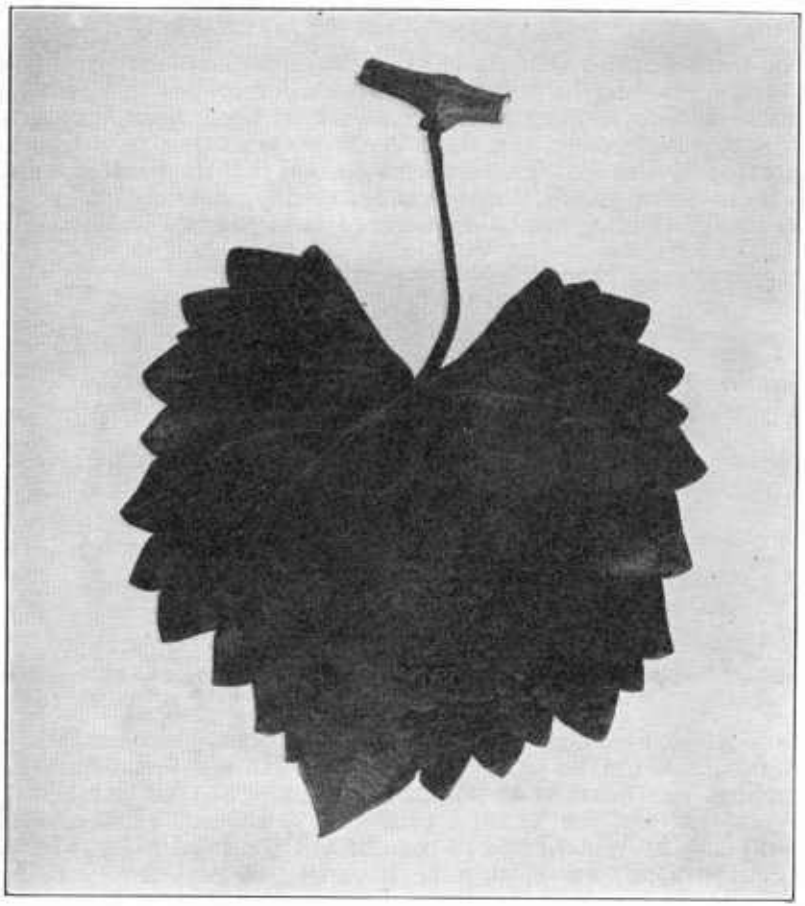


FIGURE 4.—An Eden leaf (two-thirds natural size).

seeds, while *V. munsoniana* (fig. 7) bears relatively large clusters of small berries (8 to 30) with small seeds. *V. munsoniana* vines are slender and more trailing and do not climb as high as those of *V. rotundifolia*. Their leaves are generally smaller, with narrow basal sinuses and less numerous but more prominent marginal teeth. *V. munsoniana* has the everbearing habit, and in August buds, blooms, and fruit in all stages of development may be found on the vines at the same time.

PROPAGATION

Muscadine grapes may be propagated from seed or by cuttings, layers, or grafts.

SEEDS

Muscadine grapes should be grown from seed only when it is desired to produce new varieties, as in plant breeding. In common with most other fruits, these grapes do not come true from seed.

CUTTINGS

The United States Department of Agriculture has for several years been experimenting in propagating muscadine grapes from cuttings (fig. 8). Although many methods have been tried, none has proved altogether satisfactory, and there is always a smaller production of plants than is desired. This is due to the fact that the wood of muscadine grapes is very hard, does not callus readily, and does not put out roots freely. Better results are secured in northern Florida than in

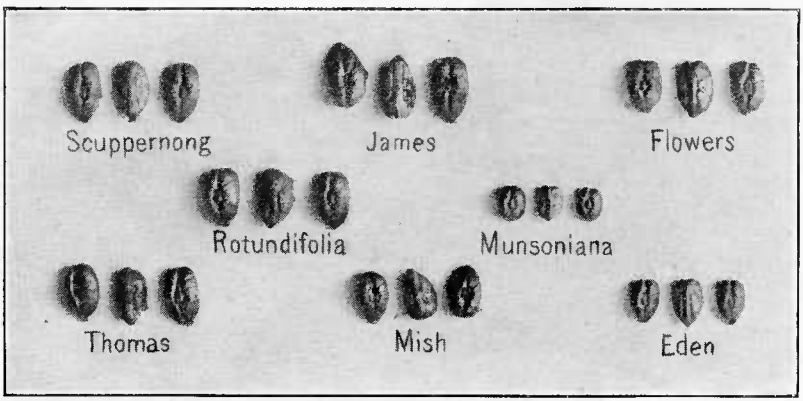


FIGURE 5.—Typical muscadine grape seeds, showing differences in size and type for different varieties. The middle seed in each set shows the reverse side.

eastern North Carolina under outdoor conditions, the climate being more favorable for the production of roots. In one test, similar lots of cuttings were planted at Willard, N. C., and at Glen Saint Mary, Fla. In this test the Thomas produced 25 percent of successfully rooted plants at Willard and 75 percent at Glen Saint Mary, whereas the Scuppernong, the most difficult variety to root from cuttings, produced only 2 percent of successfully rooted cuttings at Willard and 25 percent at Glen Saint Mary. The results in these two tests are rather typical of many other plantings at both locations and represent fairly accurately what is to be expected. In field planting, the best results have been obtained by using long cuttings (15 to 18 inches) of short-jointed, medium-sized, well-ripened wood cut in the early winter and stored in a callusing mound until about April 1 and then planted in a nursery row in well-prepared ground, with only one or two buds at the top left above the ground.

Success in rooting cuttings will be determined to some extent by moisture conditions; if the soil dries out, the cuttings will not thrive. It is also important to keep the nursery free from grass and weeds.

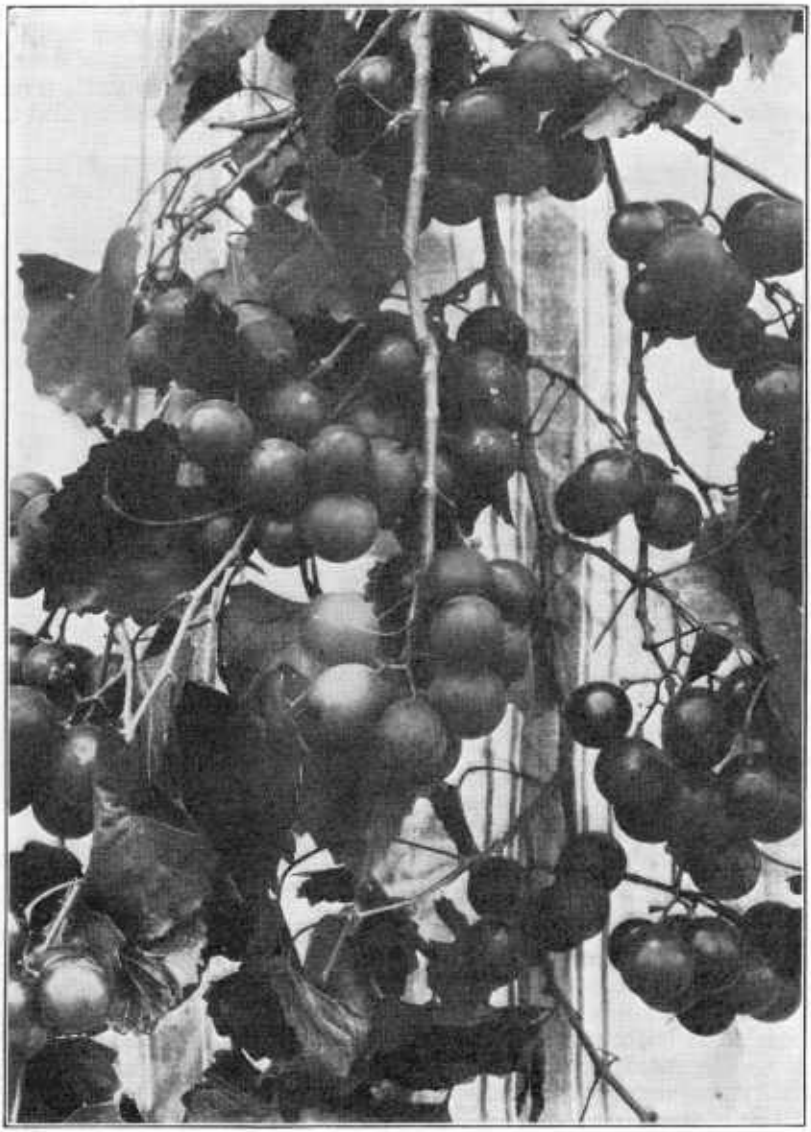


FIGURE 6.—Fruit and branches of *Vitis rotundifolia* (about one-half natural size).

Considerable difference has been found to exist in the relative rooting qualities of different varieties. Some of the staminate muscadines root with relative ease. Of the commercial varieties, the Thomas and Flowers give the best results, the James and Eden being intermediate, and the Scuppernong rooting with greatest difficulty. Memory and Creswell root relatively easily. In the most successful tests with the Scuppernong at Willard only 4 percent rooted, whereas with the Thomas as many as 48 percent of the cuttings rooted out of doors.

One means of furthering the rooting of cuttings is to graft a small piece of young muscadine root on the basal end of the cutting and then

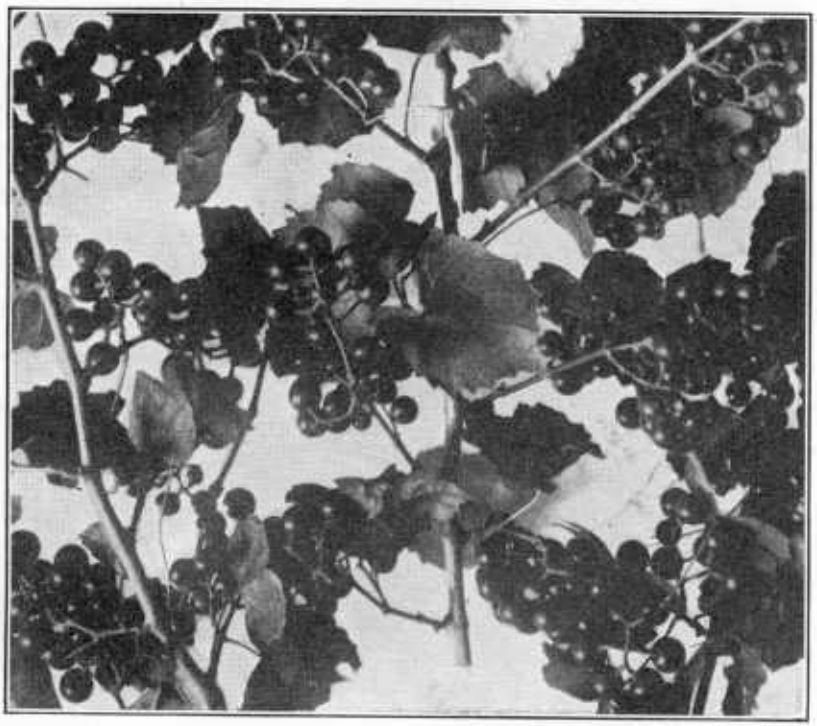


FIGURE 7.—Fruit and branches of *Vitis munsoniana* (about one-half natural size).

treat such grafts as if they were cuttings. In this manner, in a normal season, 86 percent of the Thomas and 20 percent of the Scuppernong cuttings were rooted. Expert propagators with greenhouse facilities can root muscadine grape cuttings with relative ease on a greenhouse bench with bottom heat and regularly maintained proper moisture and soil temperature. During the winter of 1936–37 a large number of varieties were successfully rooted in a greenhouse by the use of electric bottom heat. While cuttings do not give as high percentage of plants as do layers, they are easily and quickly made and can be handled in regular nursery rows, and plants grown from cuttings are much better than those from layers (fig. 11).

LAYERING

Layering is the method practiced most commonly by grape growers and nurserymen in propagating muscadine grapes (fig. 9). By this method the greatest number of plants are produced with the least expense. Such plants are, however, often poorly shaped and difficult to handle. Canes can be layered at any season of the year, but midsummer is the most favorable time. For midsummer layering, canes of the same season's growth are bent down to the ground and covered with earth, the growing tips being allowed to project above the soil. Roots will form by autumn, and the layers can then be cut from the parent vine, giving one new plant for each shoot layered. If a large branch has been layered in the fall or spring, it will generally develop shoots from a number of nodes or buds. Roots that will develop on each of these shoot bases can be cut apart during the dormant season, thus securing several plants from each long cane laid down. When such large branches or canes are used they are pegged down in trenches in the spring but are not covered with soil until after shoot growth starts from the various buds. After shoot growth has started, soil is filled in over the mother cane and about the shoot bases, leaving all shoot tips exposed. The rooted layers are generally left undisturbed until the following spring, at which time they are taken up and planted in new locations.

When vines are on overhead arbors, layers can be made by placing boxes of soil on the arbors and layering the canes into them. In dry periods the earth in these boxes should be kept moist.

When nurserymen grow muscadine vines especially for layering purposes, the vines are not trellised but grow along the surface of the ground. In July or August the current-season shoots are covered with soil, leaving the tips exposed. Each shoot so covered will form roots and can be cut away from the parent plant during the following winter. In the cutting, spurs are left which again form shoots suitable for layering the following season.

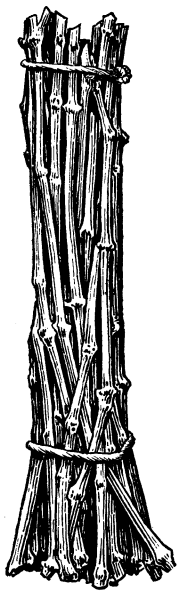


FIGURE 8.—A bundle of grape cuttings.

GRAFTING

Muscadine grapes are seldom grafted because the wood of the muscadine is very hard and the unions formed are usually poor. However, the grafting of a cutting on a more readily rooting stock may assist a muscadine-grape scion to put out its own roots. Methods of grafting are described in Farmers' Bulletin 471, Grape Propagation, Pruning, and Training.

SOILS

Muscadine grapes can be grown on almost any of the tillable soils of their natural habitat, but not with equal success; they do not thrive well in low, wet soil or on barren clay hills Generally speaking, the

best results with muscadine grapes, as with other fruits, are obtained on sandy loam soils that are well-drained and contain a fair amount of fertility and organic matter. Such soils abound throughout the southeastern Coastal Plain. They also grow successfully in the better red-clay soils of the Piedmont. Any well-drained land in the Coastal Plain where hardwood as well as pine trees grow is good muscadine grape land.

As the muscadines have a relatively shallow spreading root system (fig. 10), deep-surfaced soils, though preferable, are not absolutely necessary; however, it is important to have a good, well-drained subsoil. Muscadine planting is not recommended where a hardpan is encountered near the surface.

When once established, muscadine vines will grow in fairly wet ground though not so well as on better drained land, and the fruit will not be of a good quality. Furthermore, it is difficult to get a stand of vines in such soil unless the rows where the vines are to be planted are temporarily drained by plowing a furrow away from them on either

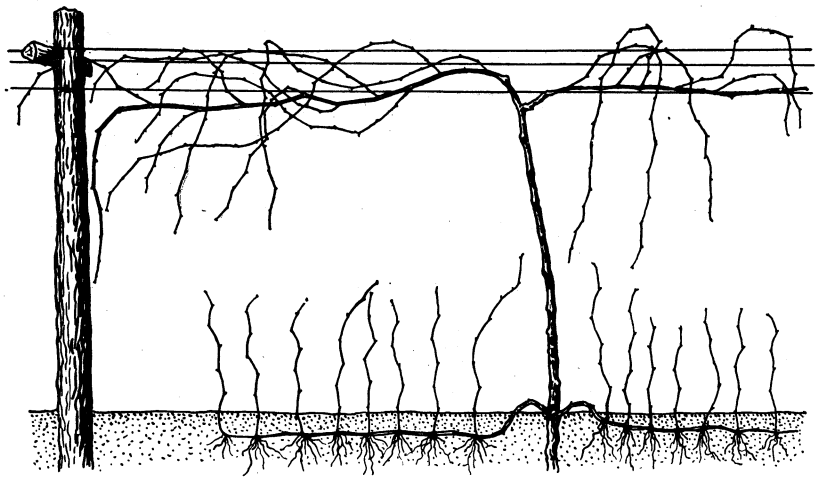


FIGURE 9.—Diagram of a grapevine with two canes layered, showing the method of propagation by layers.

side, leaving the rows as narrow strips not more than 2 feet wide. After the plants have become established, the furrows are closed.

If the vines are to be planted on new land it is desirable to grow a crop of tobacco, corn, cotton, or some other annual crop requiring cultivation and, in addition, a leguminous crop, such as cowpeas, prior to setting the grapevines. This procedure will put the ground in ideal condition for planting vines.

Muscadines grow vigorously when once established, but they are difficult to start. A large percentage of the vines in new plantings will be lost if the soil is either too wet or too dry or otherwise in poor condition.

PLANTING

Muscadines are planted in much the same way as other grapevines. The best time to plant is in early spring, preferably not later than March 1. The ground should, of course, be well prepared. Either

1- or 2-year-old vines are suitable for planting, but strong 1-year-old plants are usually preferred.

Figure 11, *A*, represents muscadine grape plants as they are received from the nursery. They should be pruned before being planted, as shown in figure 11, *B*. The tops of 1-year-old plants should be shortened to the required length, so as to leave one or two buds above ground. If the plants are more than 1 year old, the tops should be cut back to a single spur.

The hole in which the plant is to be set should be made wide enough to prevent crowding the roots and deep enough to permit several shovelfuls of good pulverized surface soil to be thrown into the bottom. The vine, when placed in position, should be as deep or slightly deeper than it was in the nursery row. The hole should be entirely filled with surface soil worked in among the roots of the plant, and the whole mass of soil should be firmed as the hole is filled.

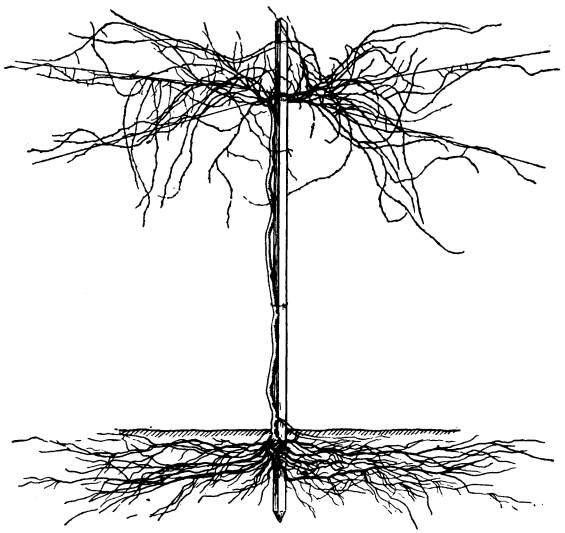


FIGURE 10.—A muscadine vine, showing its characteristic shallow, spreading root system.

It is important that the roots of the vines be prevented from drying after the vines are received from the nursery and during planting. Excessive drying of roots by the sun and wind during planting or by dry storage prior to planting may result in serious loss. Often a wet burlap bag spread over the roots is all the protection that is needed.

How far apart muscadine grapes should be planted depends upon the variety and the training system used. The James, Flowers, and Mish varieties can be grown closer together than the more vigorous varieties like Thomas, Scuppernong, and Eden. More vines per acre can be grown successfully on vertical trellises than on overhead horizontal trellises. The relative advantages of these systems are discussed under Training and Pruning (p. 19). Scuppernong vines grown on the overhead arbor or horizontal trellis have usually been planted 20 by 20 feet apart. Where the grapes are grown without intercropping it is advantageous to plant the vines about 10 by 10 feet apart and then thin them out as they begin to crowd. In this

manner, much heavier yields per acre can be obtained from the first three or four harvests, and vineyard space is not wasted. An equally practical method of handling is to set the vines 20 by 20 feet and use the interspace for other crops.

Figure 12 illustrates a good method of planting the Scuppernong variety for overhead training when the vines are set close, to be thinned as they grow larger. By this plan the vines are set 10 by 10 feet apart. The location of permanent vines and posts 20 feet apart each way is indicated by P. The vines represented by X are first fillers supported only by temporary stakes or slender posts, and they should be removed as soon as they begin to crowd; the O vines can

FIGURE 11.—Rotundifolia vines: *A*, As received from the nursery; *B*, pruned; ready for planting. The three plants on the left in both *A* and *B* were grown from cuttings; those on the right were grown from layers.

remain 2 or 3 years longer than the X vines. No. 12 wire is sufficiently large for the rows in which there are no permanent vines. These wires and the temporary posts are removed when the temporary vines are removed. This method, of course, requires the purchase of more plants and the use of additional supports at the temporary vines, but the extra yield per acre will usually take care of these costs during the first few bearing years. The grower should not hesitate, however, to cut out the temporary vines as soon as crowding begins. Under most conditions it is more satisfactory to set only permanent vines and use the space between them to grow other crops which will not interfere with the vines. If this plan is followed the intercropping of the land should be stopped as soon as the vines

are large enough to make use of all the space. Under practical vineyard management it is desirable to continue to grow soil-improvement crops between the vines, but the growing of such crops as corn, cotton, and tobacco should not be continued after the vines are in good production.

When vines are grown on a vertical trellis, the Scuppernong and similar strong-growing sorts should be in rows not less than 10 feet apart. Vines may be set 10 feet apart in the row and thinned out to 20 feet apart as they begin to crowd, as indicated in figure 13.

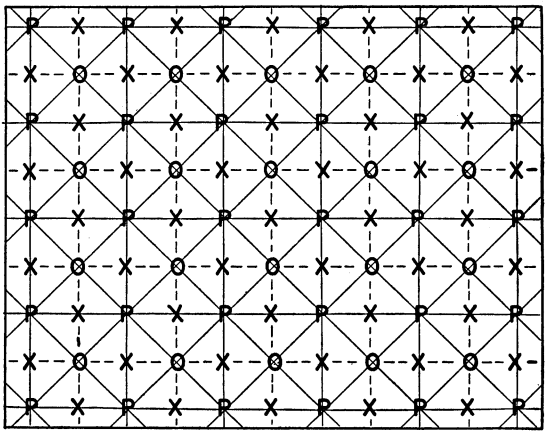


FIGURE 12.—Diagram showing a method employed in alternating permanent and temporary plantings of grapevines when set close for overhead training. *P*, Permanent; *O*, semipermanent; *X*, temporary. Solid lines represent permanent wires; broken lines, the temporary wires.

For varieties not as strong growing as Scuppernong, the vines can be originally set 8 feet apart in the row and thinned to 16 feet. With the Thomas variety, which is intermediate in vigor between the Scuppernong and the Flowers varieties, it is best to set the vines 15 by 15 feet for overhead training and 15 feet apart in rows 10 feet apart for vertical training. These last distances are also recommended for mixed plantings of both vigorous and weak-growing sorts. In fact, the writer prefers planting all but the most rangy varieties like Scuppernong 15 by 15 feet apart on the overhead trellis and 15 by 10 feet apart on the vertical trellis. This is the average intermediate planting distance generally to be recommended, for at this distance the vines will occupy the land within a few years. Intercrops can be planted during the first 2 or 3 years.

P T P T P T P T P T P T P
T P T P T P T P T P T P T
P T P T P T P T P T P T P
T P T P T P T P T P T P T
P T P T P T P T P T P T P
T P T P T P T P T P T P T

FIGURE 13.—Diagram showing a method employed in alternating permanent and temporary plantings of grapevines grown on a vertical trellis: *P*, Permanent; *T*, temporary.

SOIL MANAGEMENT

Two methods of handling muscadine vineyards have been widely used in the Southern States. One of the methods followed in the larger commercial vineyards has consisted of systematic cultivation,

the growing of soil-improvement crops, and the handling of the land much as it is handled with most orchard fruit crops. The second method followed, particularly where the overhead trellis is used and for small farm plantings, has been to maintain the vineyard in sod and use the vineyard for pasture and shade for livestock. While yields are generally much higher and the quality of fruit produced is better under the conditions of more intensive culture and careful soil management, there are advantages in the second system for the small-vineyard operator. Under that system, with a minimum expenditure of labor, some fruit can be secured. Muscadine grapes have unusual ability to thrive under adverse conditions and to produce some fruit even under serious neglect.

With either system of handling, the soil should be well prepared before the grapevines are planted. Under intensive culture, companion crops to carry a portion of the expense of maintaining the vineyard, as well as soil-improvement crops, can be grown until the time the vineyard comes into fruiting. For cash intercrops during

FIGURE 14.—Rotundifolia vines grown with an intercrop.

the first years of the vineyard, cultivated kinds such as melons, tomatoes, peanuts, cotton, or tobacco are very satisfactory. A vineyard with such an intercrop is shown in figure 14. Growing corn and grain crops appears less desirable than crops of the type listed above.

In most of the muscadine belt, after a cash crop of the type listed above is harvested, it is possible to seed an overwintering legume soil-improvement crop, such as Austrian Winter peas, vetch, or similar crops that have proved satisfactory in a particular district. These should be plowed or disked into the soil about the time they reach the blossoming stage in the spring, after which cultivated cash crops can again be planted for growth during the summer. Such a method of handling will provide the maximum cash return during the early years of the vineyard and still maintain satisfactory growing conditions for the vines.

After the vineyard has come into fruiting it is doubtful whether attempts should be made to grow such cash crops. At least one

soil-improvement crop per year, which will be incorporated into the soil, should be grown. In addition, a summer-legume crop can be planted in the spring, which can either be incorporated into the soil in the fall or can be pastured off. In general, the benefit to the soil and to the grapes is greater from the incorporation of such crops into the soil than from pasturing with livestock. Such a soil-improvement crop in the vineyard is shown in figure 15.

The growing of cash crops in the vineyard is generally less satisfactory with a vertical trellis in rows only 10 feet apart than with the overhead-trellis system. With the vertical-trellis system, one or two rows of cash crops can be grown between the vines for the first year or two but cannot be continued as long as with the overhead system. Aside from this, the methods of soil management under the two systems will not differ materially.

FIGURE 15.—Rotundifolia vines with a mixed cover crop of cowpeas and sorghum growing between the rows.

Muscadine grapes can also be grown with fair satisfaction under the so-called sod system, where no cultivation is given, but the yield will usually be less than under cultivation. Quite satisfactory yields can be secured if sufficient fertilizer is used. Under this system the soil should be well prepared before the vines are planted. Subsequently it should be hoed and weed growth kept down for a distance of 3 or 4 feet around the vines until they have become well established. If the vineyard is maintained in a grass sod, mulching with organic matter, such as straw, corn fodder, peanut vines, or similar material, by piling the material several inches deep for a distance of several feet around each vine will prove very beneficial. The use of fertilizer materials high in nitrogen in the vineyard maintained in sod is also essential to good growth of vines.

On a fairly strong soil the sod-culture method is quite satisfactory with the overhead-trellis system. It is less so with the horizontal

trellis because of the difficulty in keeping weeds and grass from contacting the grapevines.

Under the sod-culture system, occasional light cultivation to incorporate some of the organic matter into the soil will probably prove very beneficial. This has been the case with orchard crops in sod. A light disking or other cultivation once a year, or even once in every 2 or 3 years, incorporates organic matter into the soil, releases soil nitrates, and generally proves very beneficial in stimulating the growth of plants.

FERTILIZATION

In order to get the best results with muscadine grapes, commercial fertilizers are usually required in addition to good culture, intercropping, and other devices for regulating crops, such as pruning and training. Young vines, especially during the first year after planting, require principally nitrogenous fertilizers, such as nitrate of soda, sulphate of ammonia, dried blood, tankage, guano, or cottonseed meal. It is a good practice to mulch young vines with manure when it is available. Cottonseed meal is one of the best vineyard nitrogenous fertilizers, because it becomes available steadily over a long period. The object of giving young vines heavy applications of fertilizer is to induce a robust growth, which will make a vine capable of bearing a profitable crop the third year. Under ordinary conditions such results will not be obtained earlier than the fourth year. Applications should be at the rate of about one-tenth pound actual nitrogen the first year, one-fifth pound the second year, and one-third pound the third year. Thus, a material such as nitrate of soda, containing 16 percent of actual nitrogen, would be applied at the rate of about one-half pound, 1 pound, and 2 pounds per vine for the first, second, and third years.

Little experimental work has been done to determine the fertilizer response of bearing vines. Throughout the Southeastern States, soils generally are deficient in potash, phosphorus, and nitrogen. In the absence of specific information as to the response of muscadines to various kinds and mixtures of fertilizer, a mixed fertilizer fairly high in nitrogen probably is safest to use. At the experimental vineyard maintained at Willard, N. C., by the United States Department of Agriculture and the North Carolina Department of Agriculture, applications of 600 pounds per acre of a fertilizer analyzing 4 percent of nitrogen, 4 percent of potash, and 6 percent of phosphoric acid have given good results.

Barnyard manure applied prior to the spring cultivation or as a mulch on noncultivated vines will give excellent results. If the vines are not making as much growth as desired, increasing the nitrogen in the fertilizer should be beneficial. On the other hand, if the vines are overvegetative, reducing the nitrogen fertilizer will reduce growth. Once the vines are bearing, the fertilizer treatment may well be varied to fit the growth condition.

POLLINATION

The pollination of muscadine grapes has been studied very closely by various investigators. It has been determined that the varieties ordinarily grown are practically self-sterile, notwithstanding the fact that the blooms have both pistils and recurved pollen-bearing stamens.

In order to produce berries they must be cross-pollinated with the fertile pollen of staminate muscadine vines. The male flower has six tall stamens bearing fertile pollen. Careful examination shows that what appears to be a center disk of the flower is really a rudimentary pistil. The female flower has a perfectly developed pistil surrounded by six short recurved or rudimentary stamens, the pollen of which is sterile. Occasional fertile grains may occur, but for all practical purposes the female flower requires pollination with pollen from staminate or male vines. The staminate vines, of course, produce no fruit. At blooming time their larger clusters make them the more conspicuous vines. It is estimated that approximately 60 percent or more of the wild muscadine grapevines are staminate.

The pollen is carried from the male to the pistillate flowers almost entirely by insects. In the past there has generally been a sufficient number of wild male vines and of insects to insure proper cross-pollination in the ordinary small vineyard. As the number of wild male vines is reduced through the clearing of land, it becomes essential to fruit production to plant male vines here and there in the vineyards, especially in the large vineyards. Unless wild male vines are growing near the site, some should be included in even a small planting. For large commercial vineyards, including some male vines is always a safe practice. No experiments have been attempted to determine the proportion of male vines needed in a vineyard, but the opinion is common that 1 staminate vine should be planted for every 8 or 10 fruiting vines. If this rule were applied to the diagrams illustrating the manner of planting (figs. 12 and 13), every third vine in every third row, be it permanent or temporary, should be a male vine. In the diagram for planting overhead vineyards (fig. 12) a male vine should not be placed at the points represented by *O*. It is important to use only vigorous, heavy-blooming male vines that bloom simultaneously with the fruiting vines to be pollinated.

The writer's investigations relating to the behavior of insects have led to the conclusion that in North Carolina the small mining bees, *Halictus stultus* Cress., are the most efficient and useful cross-pollinators for muscadines. Other bees which tend to collect pollen by brushing it into the hairy body and legs are the next most important (green bee, *Agapostemon splendens* Lep.; gray bee, *Megachile* sp.; and small bumblebee, *Bombus impatiens* Cress.). The honeybee, *Apis mellifica* L., which collects the pollen by gluing it in two lumps (one on either hind leg), appears to be less efficient (fig. 16). The dry pollen dusted into the legs of the hairy bees can be readily germinated in the laboratory, but once the honeybee has glued pollen to its legs this pollen seems to be covered with such an impervious coat of waterproof substance that it cannot be germinated by ordinary laboratory procedure. Efforts to use it in the vineyard by hand application to receptive pistils have failed to get results. Also, the honeybee appears to carry less muscadine pollen in body hairs than the other insects listed above. While the honeybee is a less-effective pollinating insect for muscadines than for fruits with sticky pollen, such as apples, it appears to have sufficient value to warrant placing stands of bees in large vineyards during the blossoming season.

The mining bees appear to be the first and most frequent visitors to muscadine flowers. The male muscadine flowers tend to lose their bud cap first in the morning; later in the day the blooms on female

or fruit-bearing vines throw off their caps, hence the bees are attracted first to the male vines. Many observations indicate that the mining bees visit an opening blossom within a few minutes after the cap falls and within half an hour from the time the first bud opens on a cluster many insects, especially the small mining bees, have visited it and collected pollen; the insects appear not to visit later these blossoms from which pollen has been collected. When the male vine no longer affords good collecting ground the insects begin to hunt elsewhere and are attracted to the female or fruiting vines. They are now loaded down with fertile pollen collected on the male blossoms which bloomed earlier in the morning, and as they light on the female flowers this fertile pollen is deposited on the sticky surface of the pistil, where it germinates in the stigmatic fluid, bringing about cross-pollination and thereby causing the development of a berry.

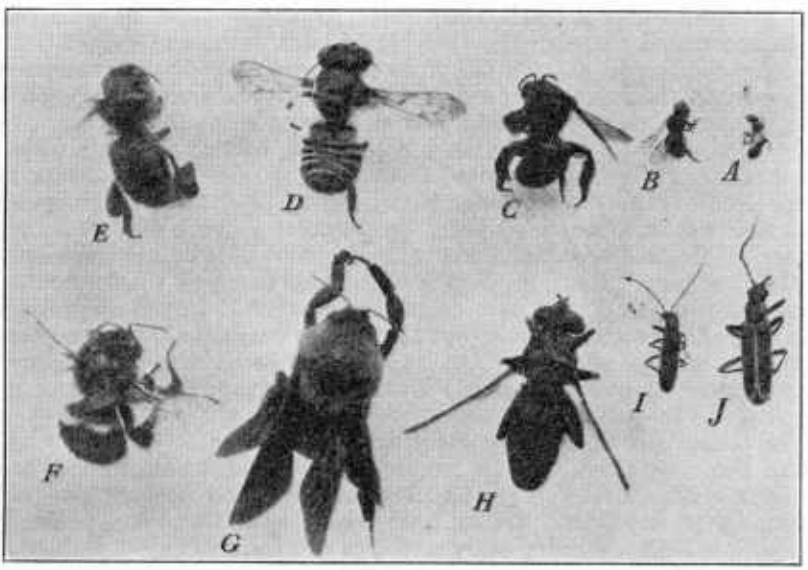


FIGURE 16.—Types of insects of value in pollinating muscadine vineyards, in order of apparent value: *A*, Small mining bee, *Halictus stultus* Cress.; *B*, large mining bee, *Halictus* sp.; *C*, green bee, *Agapostemon splendens* Lep.; *D*, gray bee, *Megachile* sp.; *E*, honeybee, *Apis mellifica* L.; *F*, small bumblebee, *Bombus impatiens* Cress.; *G*, large bumblebee, *Bombus fraternus* Smith; *H*, ornate flower fly, *Milesia virginiensis* Drury; *I*, beetle, *Copidita thoracica* F.; *J*, beetle, *Chauliognathus marginatus* F.

Investigations show that while 7 to 10 percent of muscadine buds normally produce ripe berries, 20 to 30 percent will produce berries if properly pollinated. This is equivalent to an increased yield per acre of approximately 200 to 300 percent and indicates the value of good pollination. Under perfect pollination conditions more berries may set than can possibly ripen. When this happens there is competition between the different berries in the cluster, which results in some of them falling off and others going on and developing. If perfect pollination has taken place, however, a larger number of berries will develop and greater total yields result than if the cluster has been poorly pollinated.

As a result of the breeding investigations of the Department of Agriculture a perfect-flowered type of muscadine grape has been produced (fig. 17). Selections among the male types have been made

in which the pistil, instead of being rudimentary, as in the staminate flower, has developed into a normal pistil, thus giving a perfect flower (fig. 18). Such perfect-flowered kinds do not require cross-pollination by insects in order to set fruit. It is hoped that a series of new perfect-flowered and self-fertile varieties can be developed, but for the present the grower must rely upon the male vines as a source of fertile pollen.

TRAINING AND PRUNING

In vineyard parlance, training relates to the method of distributing the vine's growth on the support, and pruning refers to the method of renewing and controlling growth by cutting away portions of the vine.

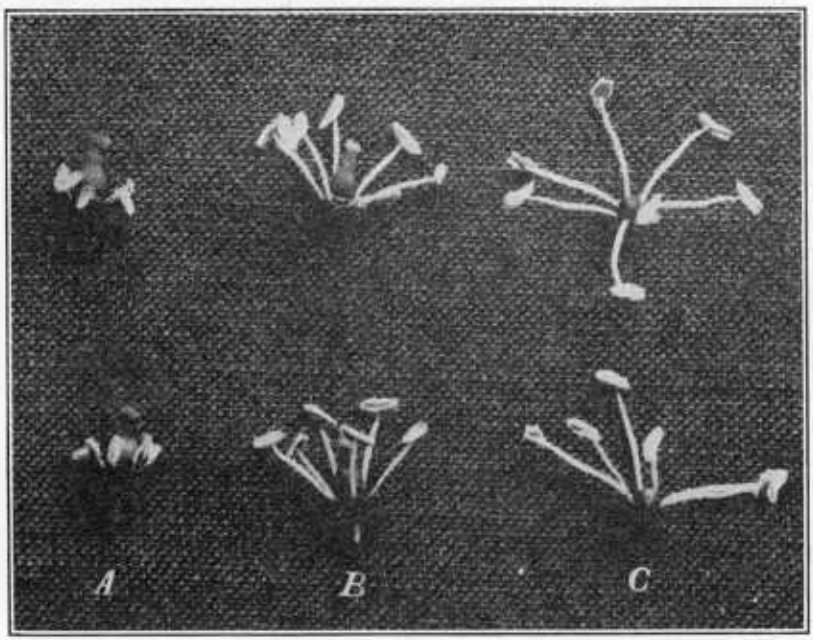


FIGURE 17.—Blossom types of muscadine grapes: *A*, Self-sterile pistillate blossoms; *C*, staminate blossoms; *B*, perfect blossoms as found on self-fertile muscadine grapes.

The systems of training followed in the growing of muscadine grapes for commercial purposes have been mostly the overhead-arbor or horizontal systems. Overhead arbors vary from the crudest supports under the scattering vines, seen about so many southern homes, to the latest type of overhead wire support used in commercial plantings. These wire supports are practically identical in construction with the parrales supports used in Spain in growing the Ohanez or so-called "Almerian" grapes.

Pruning, like cultivating and fertilizing, tends to regulate the amount and habit of wood growth and the relation of this growth to fruitfulness. It may be said, therefore, that the purpose of pruning is to regulate and maintain the balance between wood and fruit production. If a vine grows too vigorously or is too weak it will not be fruitful; if it grows moderately, yet produces a sufficient wood crop each

year to bear fruit the next year, the vine will be productive. The grower should always bear in mind that fruit is produced on the present season's growth, which comes primarily from buds on the previous year's growth. Old wood does not produce fruit, but when pruned it produces new growth which will be fruitful. When well-trained, this growth is so placed that air and sunshine can get to all parts of the vine and the fruit crop is accessible for harvest. Pruning and training also regulate the amount of fruit that can be produced, and by holding this amount within reasonable limits enables the vine to produce larger and sweeter berries and larger clusters.

Two types of training are employed for muscadine grapes: (1) The horizontal or overhead system (fig. 19), by which the growth is spread as an overhead canopy about 7 feet above the ground and supported by posts and a horizontal trellis; and (2) the upright or vertical system, in which the growth is spread over a vertical trellis (figs. 20 and 21).

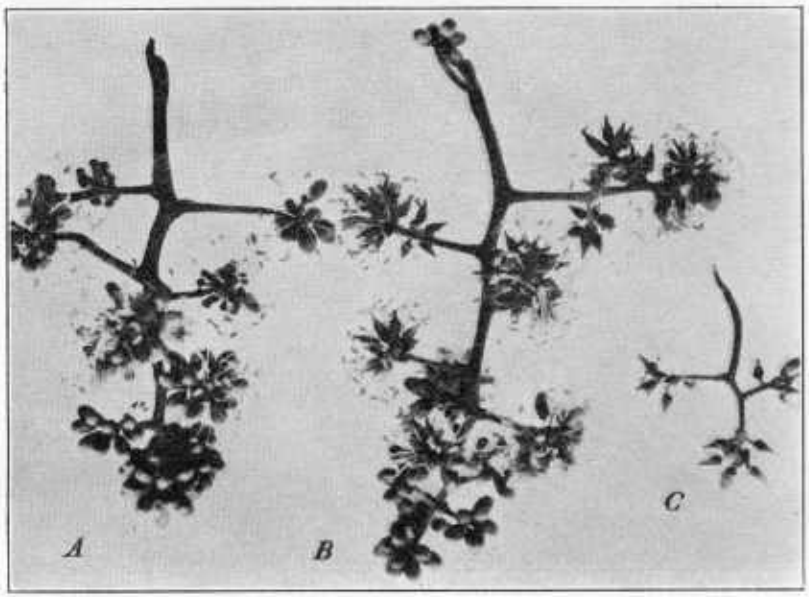


FIGURE 18.—Bloom-cluster types of muscadine grapes: *A*, Male or staminate cluster; *C*, self-sterile pistillate cluster; *B*, self-fertile cluster.

The prospective grower will need to determine which system is best for his particular conditions. Each has advantages and disadvantages.

For an overhead system the vine is trained to a single trunk from the ground alongside a permanent post. When the vine has reached the top of the post (7 feet from the ground) it is pinched off, cut back, or bent over, so as to make it throw out shoots at this point to grow and spread from this head as the spokes of a horizontal wheel radiate from the hub.

In the upright system fruiting arms either radiate from a low vine head, like the ribs of a fan (fig. 21), or they are taken off as horizontal arms from a central vertical trunk (fig. 20).

When the vineyard is not given close attention, and pruning and other vineyard practices, such as culture, fertilizing, etc., cannot be given, the best results will certainly be obtained with the overhead

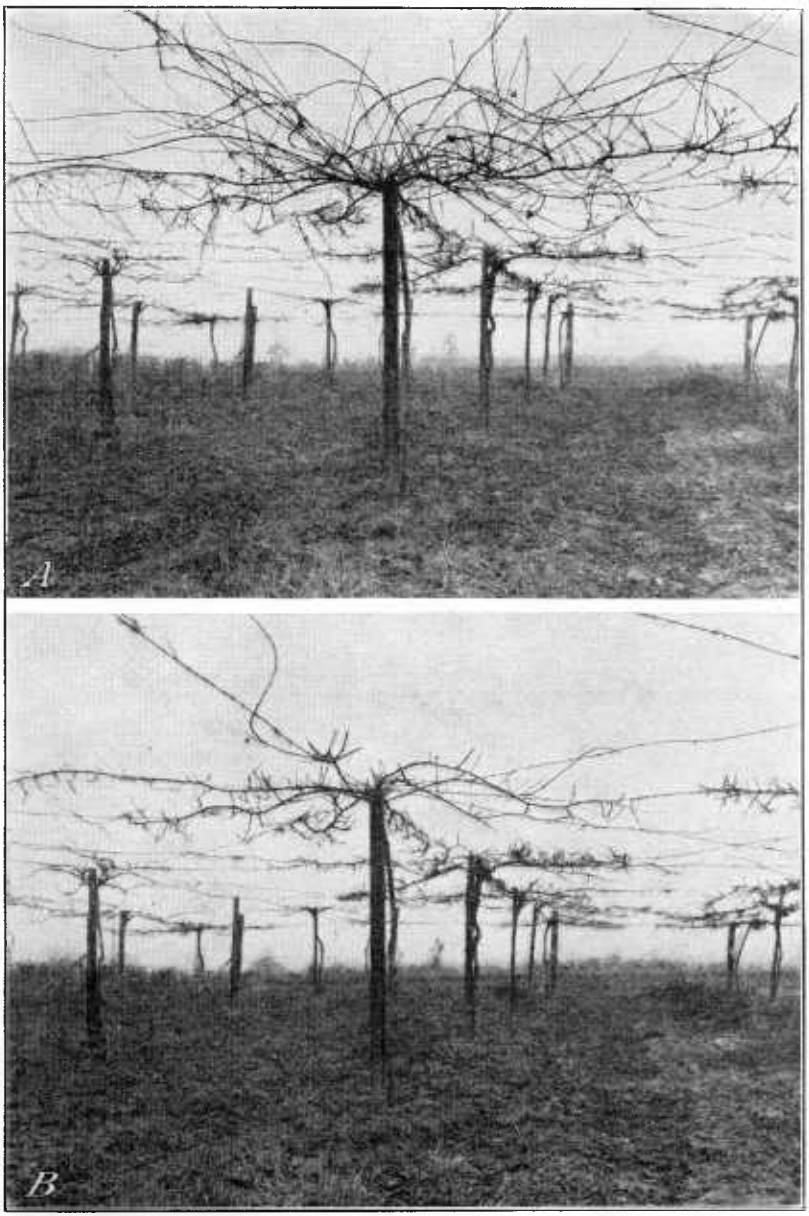


FIGURE 19.—Type of overhead trellis recommended in this bulletin: *A*, An unpruned vine in the foreground; *B*, the same vine after it was pruned. The brush removed from the other vines can be seen here and there on the ground, especially at the right. (Photographs courtesy of J. Horace McFarland Co., publishers, Harrisburg, Pa.).

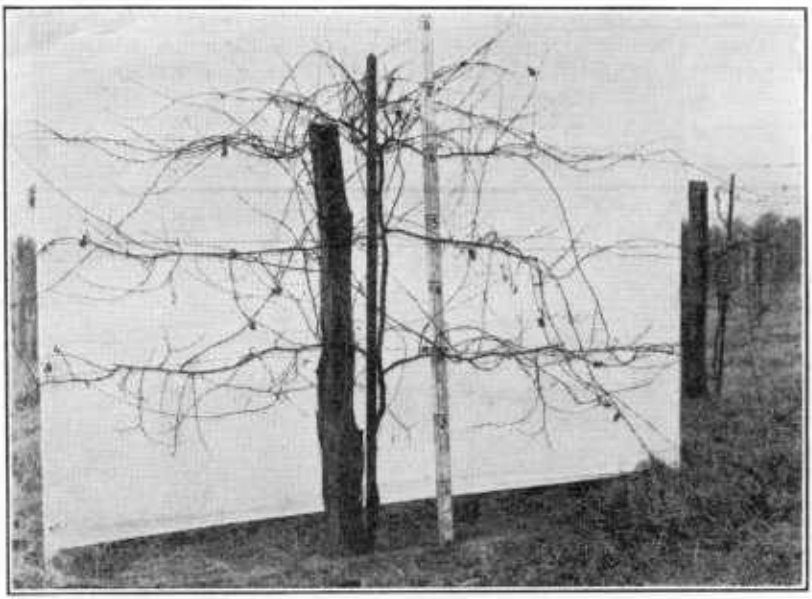


FIGURE 20.—An unpruned rotundifolia vine trained in accordance with the six-arm renewal system on a vertical trellis.

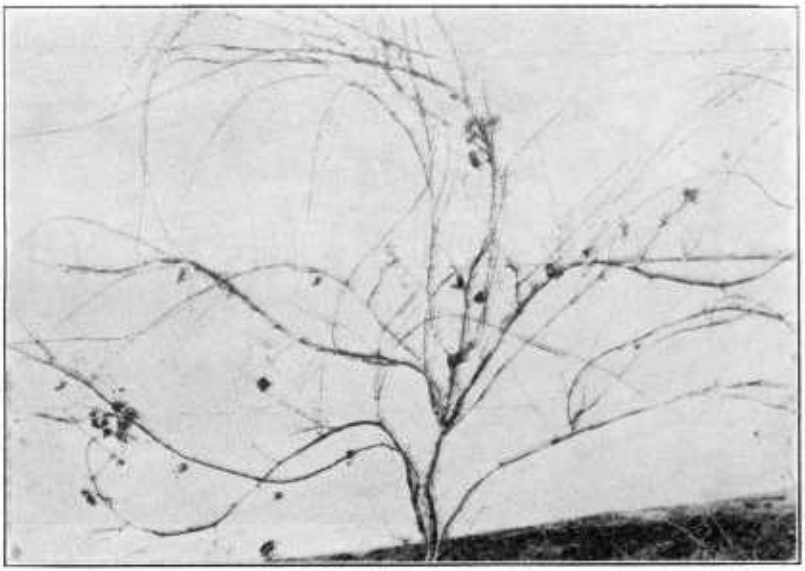


FIGURE 21.—An unpruned rotundifolia vine trained in accordance with the radiating or fan system on a vertical trellis.

trellis. Moreover, such a trellis permits cross-plowing and cultivation and is better adapted where hogs, sheep, or cattle are to graze on cover crops grown in the vineyard. It will be seen, therefore, that an overhead system is also fairly satisfactory from the standpoint of the intensive vineyardist who proposes to give his vines the best attention.

The upright trellis, on the other hand, facilitates pruning, harvesting, spraying, and intercropping throughout the life of the vineyard. It is easier to repair and can be erected at a cost of from $10 to $20 an acre less than the overhead trellis. For varieties that tend to be weak in growth and bear overload crops the upright trellis and fan system of training tends to stimulate wood growth. These weak-growing, heavy-producing varieties therefore tend to thrive better and live longer with the fan system of training than on the overhead system where the arms are horizontal. On the other hand, the more vigorous varieties like Scuppernong are not readily trained on the upright trellis, because their ranging growth and the resulting necessity of severe pruning throws them into such vigorous growth that they cease to be as fruitful as they otherwise would be. Vigorous varieties, therefore, are better adapted to training on the overhead horizontal trellis and the weak-growing, heavy-producing varieties to the upright trellis and fan system of training.

The opinion has been widely held that muscadine grapes do not require pruning and, in fact, that pruning is definitely injurious. It is true that many old unpruned vines, particularly when growing on an overhead trellis, sometimes bear very heavy crops. Under such conditions, however, production is very irregular, extremely heavy crops generally being followed by years of very poor production. Also, in the heavy crop years the fruit is small, ripens poorly, is low in sugar content, and is inferior in quality. Frequently following such heavy production the vines are much more subject to winter injury, and there will be severe die-back of canes. With weak-growing varieties the whole vine may die as a result of such overproduction.

Under a program of systematic pruning, production is much more regular. The fruit is larger, ripens better, and is of much better quality. Experience has shown that at least for the commercial vineyard a systematic pruning program should be followed, in order to produce regular crops of good-quality fruit and to prolong the bearing life of the vineyard.

The pruning of muscadine grapes during the first 3 years is based primarily on establishing the permanent parts of the vine and adjusting the other parts to a definite training system. During the first season after planting, the trunk should be established. With an overhead trellis a single trunk is carried from the ground up to the wires overhead. Laterals which develop along this trunk should be pruned off during the dormant season, and any additional canes which start growth from the base of the vine should be removed. Similarly, with a vertical trellis the trunk should be established during the first growing season. Figure 11, *B*, shows the manner of pruning muscadines when planted. Figure 22 shows how the vines should look at the end of the first and second vineyard years when trained to the horizontal or overhead system. Figure 23 shows how the vines should look after being pruned at the end of the first, second, and fourth vineyard years when trained to the vertical radiating system. Figure

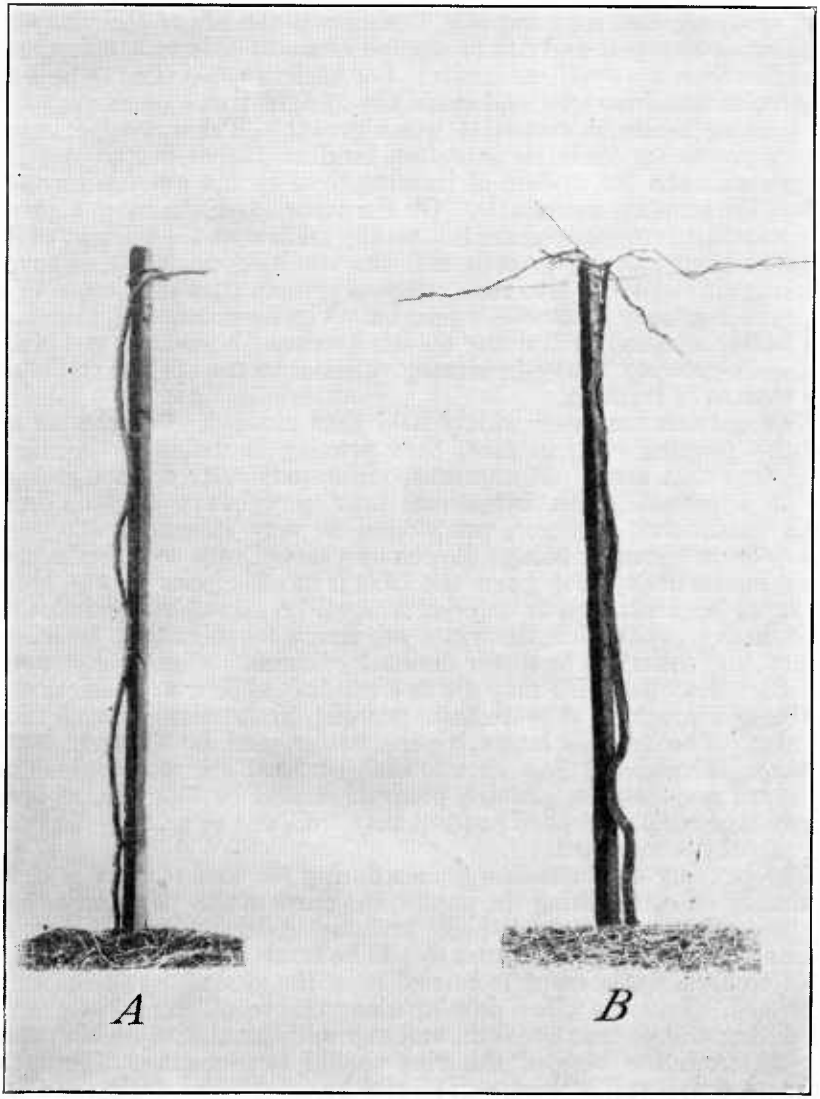


FIGURE 22.—Rotundifolia vines trained in accordance with the horizontal or overhead system: *A*, End of first vineyard year; *B*, end of second year.

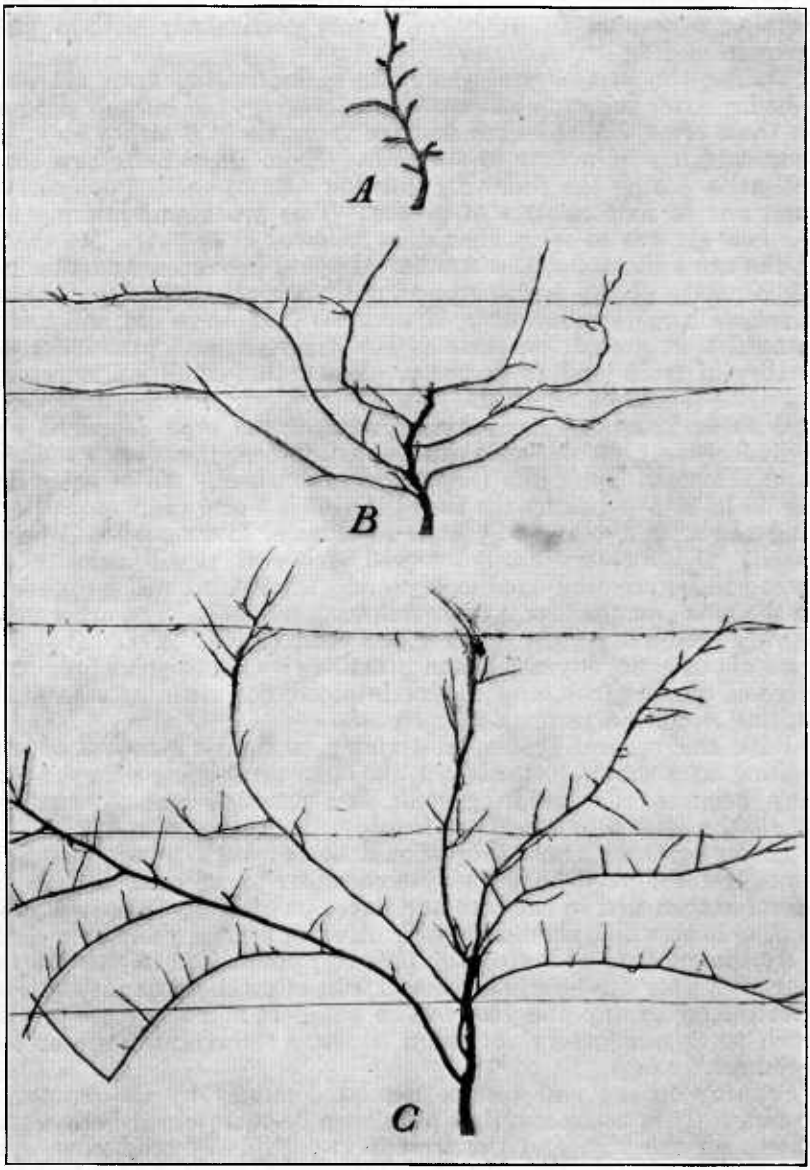


FIGURE 23.—Rotundifolia vines trained in accordance with the vertical radiating system: *A*, End of first vineyard year; *B*, end of second year; *C*, end of fourth year.

24 shows vines of similar age after pruning, when trained to the vertical six-arm system. Figure 19 shows an older unpruned vine on a horizontal overhead system, figure 20 a similar vine on a vertical six-arm system, and figure 21 a similar vine on the vertical radiating system. A careful study of these illustrations will give a general idea as to pruning procedure from year to year, particularly with a young vineyard.

During the first several years the main fruiting arms are established. After the vine has come into bearing, the laterals produced on these arms should be cut back to spurs about 6 inches long, each spur carrying from four to six buds. From these buds new shoots will arise during the following growing season, each shoot carrying from one to four clusters of grapes. This process of pruning back the new growth to spurs should be followed each year. As the age of the arms increases, the number of spurs increases, and the fruiting capacity of the arm increases until it reaches an age of several years. Ultimately, however, these arms become so old and heavily spurred that growth on them is less vigorous, and production and quality of fruit tend to decrease. When this condition is reached, the arms should be renewed.

With an overhead horizontal system of the type described here, eight fruiting arms per vine can be maintained, these arms radiating from the main trunk like the spokes of a wheel. All of these arms should be established by the time the vine is 5 or 6 years old. Beginning about that time, a systematic renewal of arms should be followed. If the oldest arm is renewed each year, it will mean that all arms will be renewed once in 8 years. Little fruit will be produced on the new arm the first 2 years following renewal. The arms should be very productive at from 3 to 7 or 8 years of age. Renewal of these arms about every 8 years has in practice given consistent production of good quality fruit and has maintained the vines in satisfactory fruiting condition through many years.

With the vertical system of training, a similar removal of main fruiting arms should be practiced, the older arms being removed when they begin to decline in growth and productiveness, which will usually be after 6 to 8 years of fruiting.

To renew these arms, they should be cut back to where a fairly strong lateral may be growing somewhere near their base. This lateral is then tied to the wire and develops after a year into a young fruiting arm, which should prove fruitful for several years.

By this method of systematic pruning, production in the vineyard year after year can be equalized and fruit of excellent quality secured. Overfruiting in any one year can be avoided, and the vines are in a much more satisfactory condition to stand unfavorable winter temperatures.

Fruiting on the vine can be regulated largely by the amount of pruning. It is necessary that a balance be maintained between the growth on the vine and the fruit it is capable of producing. If a vine is becoming overvegetative, a little more wood should be left at pruning time, the spurs being left a little longer and with more buds. On the other hand, if the growth of the vine is becoming too weak it is an indication that it may have overfruited, in which case the pruning during the following season should be heavier, leaving fewer buds for fruiting during the next year. This can be accomplished by

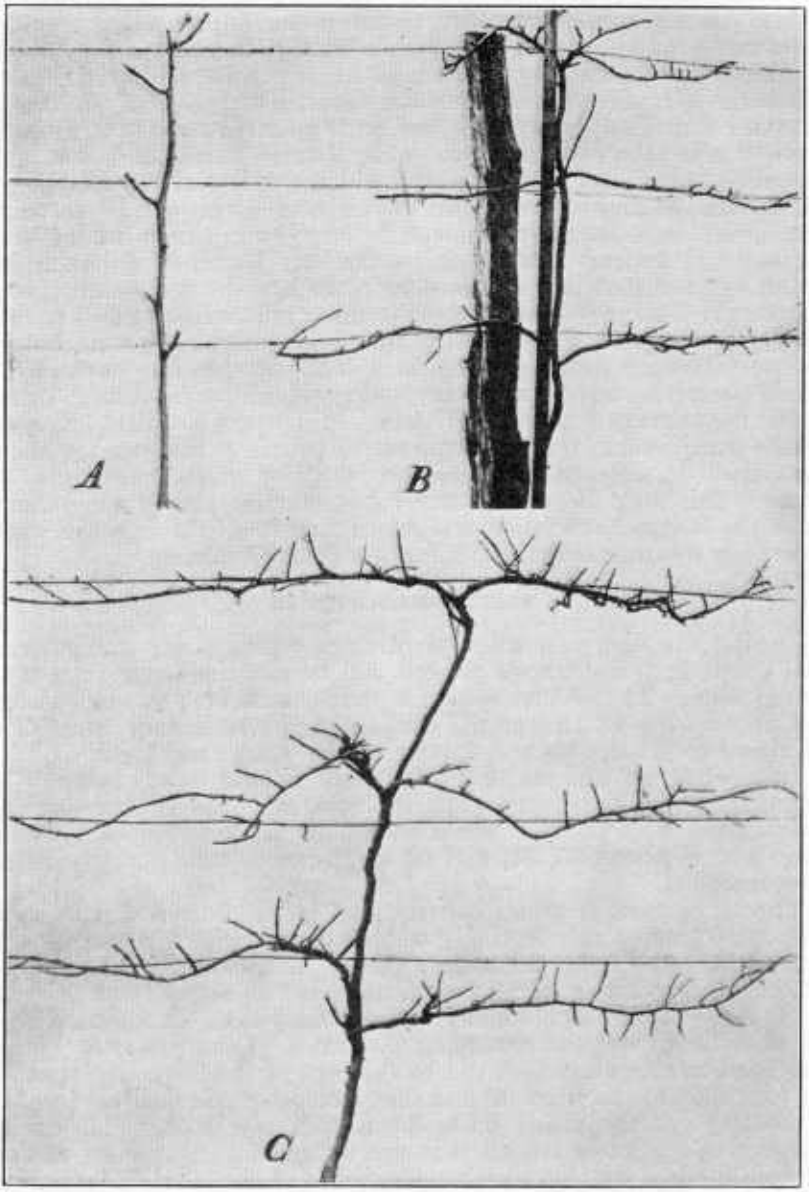


FIGURE 24.—Rotundifolia vines trained in accordance with the vertical six-arm renewal system: *A*, End of first vineyard year; *B*, end of second year; *C*, end of fourth year.

leaving the spurs shorter and by removing some of the canes entirely, leaving no spurs for fruiting the following season. Severe pruning tends to make the vines more vegetative, while light pruning tends to give heavy crops and limited vegetative growth. Pruning and other cultural practices must therefore be adjusted to provide a balanced production and growth condition each season.

Muscadine vines may be pruned at any time during the season when the foliage is off; the safest time is after danger of severe freezing weather is passed, but before the buds start to swell. If vines are pruned after the buds start to swell, they will tend to bleed. This so-called "bleeding" of grapevines, which consists of sap running out of the vine at any injured point about the time growth is starting in the spring, was formerly believed to be very injurious to the vines. Actually it appears not to be particularly harmful, although it is recommended that pruning be done early in order to avoid excessive bleeding. The very best time for pruning muscadine as well as other grapevines appears to be shortly after midwinter. If severe freezing occurs following pruning, there is a tendency for the tissues to be killed back from the cut surfaces; thus greater injury results to pruned than to unpruned vines. With fairly large vineyards, however, where considerable time is required for pruning, the pruning should be started in time to complete the job prior to the swelling of the buds. This may mean, in many cases, starting the pruning shortly after the leaves have fallen and continuing it all through the winter when the weather is favorable for work of this nature.

TRELLIS CONSTRUCTION

During the first year after planting, a strong stake firmly placed and reaching 7 feet above ground will be sufficient support for the young vine. The second season a trellis must be provided, though the upper wires of an upright trellis and the secondary wires of an overhead trellis can be added later as the vines need them.

In erecting an upright trellis the posts should be set midway between the vines, the distance apart varying with the distance between the plants. End posts of the rows should be firmly braced. Three wires placed about 30, 54, and 66 to 72 inches from the ground are recommended.

There are various styles of overhead trellis, but it is most satisfactory to place a substantial, durable post reaching 7 feet above the ground at each of the permanent vines. Rows of extra-heavy, well-braced posts running parallel with and also at the ends of the rows of vines are set at the boundaries of the vineyard. There are a number of different ways of arranging the wires. Usually no. 10 galvanized wires are securely fastened to the tops of the boundary posts on the four sides of the vineyard and then run along and securely fastened to the tops of the inside posts down each row in both directions. These primary wires are all that are needed for the second season. The old method was to run secondary wires of no. 14 size 2 feet apart, parallel with the primary wires, until in this manner the entire area had been covered. Over this checkerboard of wiring the vines trailed. This method of wiring does not permit of ready pruning, and under intensive culture, where the vines are carefully pruned and trained, a different arrangement of wires is preferable. After establishing the primary wires in the second year, another no. 10 wire is run diagonally

in one direction the third year, and the following year a similar wire is run diagonally in the other direction. Thus four different wires are made to cross each other at each post where a permanent vine is located, thus providing support along the wires for eight fruiting arms.

Some growers construct arbors entirely of wood, using slats and poles instead of wire, but such trellises are less durable and satisfactory than wire trellises.

HARVESTING AND HANDLING

Muscadines have the toughest skin and are the most resistant to handling injury of any grapes. The usual practice of harvesting these grapes for juice purposes is to jar them from the vines onto canvas or burlap sheets spread or carried under the vines. The leaves, twigs, etc., accumulated with the fruit are separated from it by hand-picking and rolling the fruit back and forth on the cloths, or by running the fruit through a fanning mill or some other blowing apparatus. Formerly, after being cleaned the jarred grapes were put in barrels and either hauled or shipped to the winery or used locally; now the large wineries establish receiving depots in the various towns and cities, where the growers can secure bushel baskets in which to place the grapes. They are then brought to the depot and weighed in. Sixty pounds is considered a bushel, and the grower is given a check on the basis of the weight of the fruit brought in. The receiver then loads this fruit onto trucks and hauls it to centralized wineries. In this way large plants draw their supply of fruit from a wide territory surrounding the plant.

The skin of most muscadine varieties is sufficiently tough to stand the rough treatment of jarring from the vines and cleaning without excessive injury to the fruit, provided all operations are done carefully and the fruit is delivered to the buyer promptly. Some bruising and injury inevitably occur and, unless the fruit is sent promptly to the winery and is put through the crusher, excessive decay is likely to develop. If the fruit is rapidly and carefully handled, however, it can be delivered to wineries in satisfactory condition.

When fruit must stay in good condition for several days after harvest, hand-picking is essential; therefore, for table use or shipping, all fruit should be hand-picked. The varieties that do not shatter from the stem readily are best for shipping. Such grapes should be carefully and attractively packed. The ordinary strawberry crate and the 2-quart and 4-quart grape baskets are the containers generally used (fig. 25).

YIELDS

As no accurate records of yields have been kept in the older commercial vineyards, little authentic information is available. The Scuppernong, which is the variety in greatest demand and for which the wineries pay the best prices, yields relatively small crops as compared with the James, Thomas, and other prolific sorts. An average yield of 25 to 30 bushels of grapes per acre from 4-year-old vines, 50 to 75 bushels from 5-year-old vines, and 100 to 150 bushels from vines in full bearing should be obtained from the average variety receiving good care. Great variations in the yields occur, however. Inferior crops may be caused by wet, cool weather at blooming time, late frosts,

FIGURE 25.—Hand-picked muscadine grapes ready for shipment.

black rot injury to bloom and foliage, weak old vines, lack of pruning, or lack of fertilization, etc. While yields of 150 to 200 bushels per acre are occasionally reliably reported, an average yield over a term of years of 75 bushels of Scuppernong and 100 to 125 bushels of the more prolific varieties would be considered most satisfactory.

The price paid for grapes varies somewhat with the seasons, the quality of fruit, the variety, and the condition of the market. In years of light crops higher prices are paid. Hand-picked fruit of good quality, attractively packed, sells for more than similar grapes shattered from the vines. Generally the light-colored varieties sought by the wineries have sold for higher prices on the general market than the dark-colored ones. The average price paid for white shattered grapes in recent years for use in wine making has been about $1 a bushel of 60 pounds. In some instances there has been a discrimination against the black grapes, and the price has been somewhat less for them than for Scuppernong; however, some of the dark grapes make as good wine as do the white varieties. Prices paid for grapes for table use are generally higher in the larger cities than in the villages or towns of the South. A limited quantity of choice, hand-picked fruit in half-bushel baskets, tubs, berry crates, or grape baskets usually sells at prices approximately double those paid for shattered wine grapes. Certain growers have built up an excellent trade for hand-picked fruit, selling it at their vineyards and sometimes shipping it to distant customers who are familiar with the muscadine grapes. For such trade, of the leading varieties, James and Mish are best suited, as they tend to shatter less than other varieties and ship well. If sold locally, however, the Thomas and light-colored varieties are as satisfactory and are preferred by some customers.

USES OF MUSCADINE GRAPES

Muscadine grapes are used principally for wine making, this wine being made by vineyardists and sold retail or by large companies which operate as national organizations having wineries at strategic points throughout the country. At the present time small local wineries are being established. In the past Norfolk, Va., and Wilmington, N. C., have been the principal points at which great quantities of grapes were received and made into wine. The wine made from Scuppernong and other muscadine grapes has a characteristic flavor and quality and has always been in demand. It is a distinct type of native American wine.

An unfermented juice for home and market can be made. The Thomas variety is especially adapted for this purpose, and the juice is highly prized as a summer fruit drink in the South, where it is known. The more acid muscadines require the addition of sugar to make a satisfactory juice.

As a table grape or as a fruit to be consumed fresh, muscadines are relished, especially if eaten soon after they are picked from the vines. It is a social custom in the South to visit under the arbors and eat the grapes fresh from the vines. Throughout the territory certain vineyards are recognized as public institutions and are visited by many people during the fruiting season.

As most of the varieties shell from the cluster when harvested, they are not generally adapted for shipping, but certain varieties can be shipped successfully. Their shipment as fresh fruit, however, is a

relatively undeveloped phase of the industry. All muscadine grapes make excellent jellies, preserves, catchup, and other culinary products, certain varieties being particularly adapted to each of these products. The canned grapes are used for pies.[1]

INSECT ENEMIES AND DISEASES

Muscadine grapes are generally considered remarkably free from insect enemies and diseases. There are, however, insects and diseases found on them which, while not serious at the present time, had best be noted and observed. The most important disease is the black rot (*Guignardia bidwellii* (Ell.) Viala and Ravaz), which so generally attacks other grape species. This disease does not seriously affect the fruit of muscadines as it does euvitis varieties, but it blights the bloom buds in unfavorable growing seasons. It affects the foliage of muscadines, as it does that of euvitis vines, by causing brick-red disease areas in which spore cases resembling tiny black dots may be noted. The remedy for this disease is to spray with bordeaux mixture. Directions for spraying may be obtained from the United States Department of Agriculture, State agricultural experiment stations, or county agricultural agents. Insects worthy of note are the grapevine flea beetle (*Haltica chalybea* Ill.) and certain unidentified snout beetles, but the injury they do is at present negligible.

VARIETIES

It is not possible to give detailed descriptions of varieties in a bulletin of restricted size. Only general descriptions of the leading varieties will be given.[2]

Muscadines of a particular color have often, though erroneously, been considered as belonging to a single variety. Color is determined by the amount of colored pigment present in the skin. If there is none of this pigment present the berry is said to be "white", bronze, or green. Small quantities of the pigment give a berry a slight pinkish color; with more pigment present the berry is decidedly pink; with still more it becomes red, purplish red, black, and finally jet black. In the collection of varieties at Willard, N. C., every gradation in color can be found. It is better, therefore, to know the varieties by names rather than to attempt to distinguish them by color or to group them in color groups.

SCUPPERNONG

The Scuppernong is probably the oldest cultivated variety of native American grapes. Although the place of origin cannot be stated positively, owing to the age of the variety, it has been pretty definitely established as being in Tyrrell County, N. C., before 1760. From there it was soon distributed over the northeastern part of North Carolina and to Roanoke Island. In this section many large old Scuppernong vines are to be found, some of which are known to be over 100 or 125 years of age. An old vine growing on Roanoke Island is said to have been planted by Sir Walter Raleigh and to be the original Scuppernong. Those who have investigated most closely the

[1] For further information on the utilization of muscadine grapes see Farmers' Bulletin 1075, Unfermented Grape Juice, and Farmers' Bulletin 1454, Home Utilization of Muscadine Grapes.

[2] Those desiring detailed descriptions are referred to U. S. Bureau of Plant Industry Bulletin 273, The Muscadine Grapes, published in 1913. Out of print, but may be consulted in libraries.

origin of the variety, however, adhere to the theory that the original vine grew wild in Tyrrell County, in the vicinity of the Scuppernong River.

From the vicinity of its origin the variety was distributed throughout the eastern part of North Carolina and was planted in vineyards ranging in size from a few vines to many acres. Some of these vineyards have been steadily enlarged, but many were allowed to deteriorate. From these vineyards the variety was gradually distributed over the Coastal Plain and Piedmont of the Southeastern States. It has steadily increased in popularity and is today the leading variety.

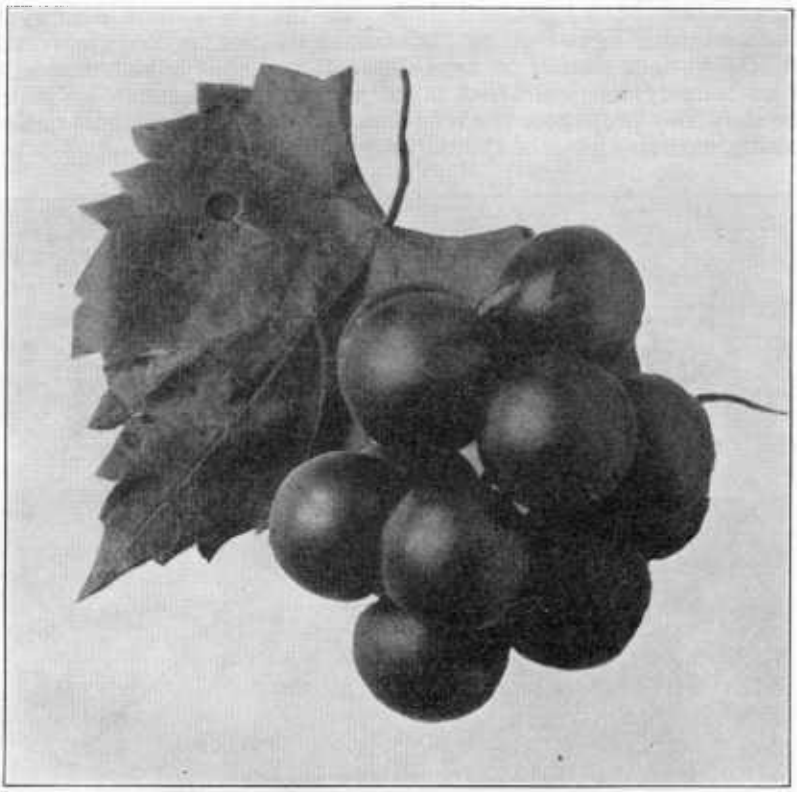


FIGURE 26.—Leaf and cluster of the Scuppernong grape (two-thirds natural size).

The vine is productive and vigorous, a rank grower, with long, slender, smooth, yellowish canes covered with small, light-brown dots or lenticels. It thrives best in well-drained sandy loam soils. The leaves (fig. 26) are of medium size, cordate, with the margin medium serrate. In texture the leaf is smooth and rather thin in comparison with other varieties. The cluster is small, having 1 to 15 but generally 2 to 6 berries. The berries average three-fourths of an inch in diameter and when fully ripe vary in color from pearly green to reddish brown, depending on the amount of exposure to the sun the individual cluster and berry has had. They ripen fairly early, and the individual berries shatter readily from the cluster when ripe. The

skin of the berry is medium tough and is covered with numerous small russet dots and sometimes russet blotches. The flesh is pale green, juicy, soft, musky, sweet, sprightly, and of good quality. The seeds are large. This variety is suitable for home use and wine making. It yields well but is not so productive as the James or Thomas.

Some confusion has arisen in the past owing to the variety name, Scuppernong, having been rather loosely used. The leading grape growers, wine makers, nurserymen, and horticulturists in the muscadine-grape district agree that the name should be applied only to the single variety of the muscadine grapes which has just been described. The name Scuppernong is sometimes incorrectly used to designate other or all varieties having light-colored fruit, or even all the varieties, both light and dark. In the past, some nurserymen have sold other light-fruiting varieties as the Scuppernong; nevertheless, the variety should be kept distinct, and it is hoped that in the future nurserymen will assist in keeping it true to name by making sure that they propagate the true Scuppernong. Other light- or dark-fruiting varieties have or should be given other names.

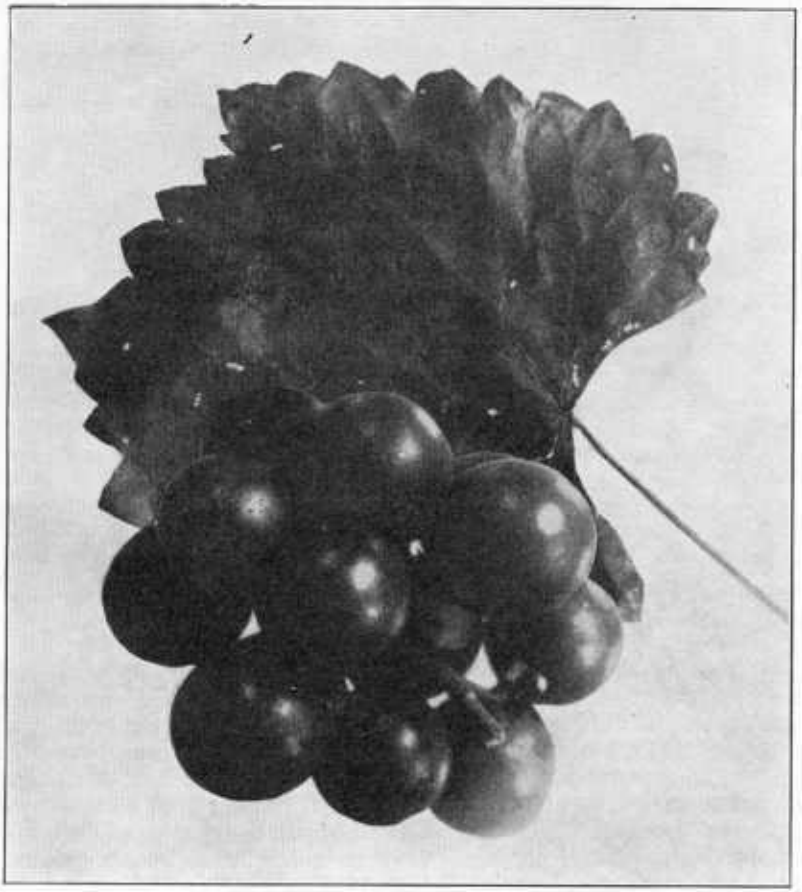


FIGURE 27.—Leaf and cluster of the Mish grape (two-thirds natural size).

MISH

The Mish variety (fig. 27) was discovered by Albert Mish between 1840 and 1850 growing in pure river sand near Washington, N. C. The vine is very productive and a vigorous, rather open, slightly trailing grower. The leaves are thick, rather round, and above medium size. The cluster is of medium size, the berries adhering fairly well to the pedicel. The berries range from about eleven-sixteenths to three-fourths of an inch in diameter, are slightly ovoid, almost black, and have numerous "guinea-egg" specks. The variety ripens uniformly but late. The skin is medium thin, cracking in wet weather. The flesh is tender, juicy, and sweet; the flavor is distinct, delicious, and of fine quality. The Mish is a fine all-round variety and next to the Scuppernong is most highly esteemed as a wine grape.

JAMES

The James was discovered about 1866 or 1867 by B. W. M. James in Pitt County, N. C. It thrives in fine sandy loam soils with clay subsoil. The vine is very productive and a vigorous, slightly trailing grower. The leaves are cordate, nearly as broad as long, medium-sized, with serrate margin; in late summer they have a mottled yellow and green appearance. The cluster is round, with rather glossy, bluish or deep-purplish black berries when fully ripe, having pronounced not very numerous guinea-egg specks. The variety is rather late in ripening, and when the berries are not fully ripe there is a characteristic reddish coloring around the pedicel. The berry is very large and juicy, and the flesh is meaty; the flavor and quality are medium; and the skin is thick and rather tough. The individual berries are very large. The James is the all-purpose grape of the muscadines, being good for dessert, market, wine, or culinary uses.

FLOWERS

The Flowers grape was discovered by "Popping Billy" Flowers in 1819 growing in a sandy loam soil in Robeson County, N. C. The variety thrives in northern Florida and is said to do well as far south as the Florida Keys. The vine is a very productive and upright, slender, rather open, moderately robust grower. The leaves vary, but are usually of medium size, longer than broad, pointed, cordate, thick, dark green, slick, and leathery, with the margin sharply serrate. The cluster is round, containing generally from 6 to 10 medium-sized purplish-black, slightly oval berries. The variety ripens late. The skin is very thick, tough, and faintly marked with dots. The flesh is white, meaty, tough, and not very juicy. The flavor is sweetish, lacks sprightliness, and is of medium quality. The variety makes good wine. Although the skins are thick they cook quite tender, and the variety is accordingly good for certain culinary uses, such as spiced grapes, conserves, and catchup.

THOMAS

The Thomas grape was discovered between 1850 and 1855 by Drewery Thomas near Marion, S. C., growing in a fine sandy loam with fine clay subsoil. The vine is very productive and a vigorous, rank grower. The leaves are cordate, rather large, longer than broad, rather thick, with serrate margin. The variety ripens in early mid-season. The cluster is round and small. The berries are of medium

size, round, and, when fully ripe, of a dark wine color. Surrounding the base of each berry is a wide, prominent, irregular, greenish-yellow pentagonal marking. The berries ripen unevenly and adhere poorly to the pedicel. The flesh is tender, juicy, very sweet, and has an exceptionally rich, fruity, sprightly flavor. The skin is thin and moderately tough, with numerous pimples dotting the surface. This is the best standard variety for unfermented juice and preserve making.

EDEN

The Eden was discovered on the premises of a Dr. Guild, near Atlanta, Ga., growing in typical piedmont red-clay soil. The vine is exceedingly productive, vigorous, with dense foliage and dark-colored wood. The leaves are medium in size and thickness, rounded, with wide basal sinuses and rounded marginal teeth, and blunt tip. The variety ripens very early and uniformly, though the vines produce distinct first and second crops. The clusters are loose, containing from 5 to 25 berries. The berries are round, about one-half inch in diameter, dull black when fully ripe, faintly speckled, and adhere fairly well to the pedicel. The flesh is soft, juicy, and colorless, with a pleasant, sprightly flavor. The quality is very good. The skin is relatively thin and tender. The variety is well adapted for making wine and for home and kitchen uses. There are many points about the Eden suggesting that it is a natural hybrid between the *rotundifolia* and the *munsoniana* species.

OTHER VARIETIES

Other varieties of more or less prominence, named in the order of their estimated value, are Creswell, Memory, Luola, Smith, Hopkins, Latham, Lady James, Pee Dee, Sugar, Carolina Belle, Beula, Tenderpulp, Clayton, West Brook, and Brown. There are still other named sorts, but they are relatively unknown and, like some of those already named, cannot be found in commercial nurseries. A series of muscadine grape hybrids produced by the late T. V. Munson, of Denison, Tex., although equal in merit to some other varieties named, are of interest chiefly to grape breeders. As a result of the breeding work of H. P. Stuckey, the Georgia Experiment Station introduced a series of varieties which are valuable contributions, but there has not been time as yet to test them generally.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE WHEN THIS PUBLICATION WAS LAST PRINTED

Secretary of Agriculture	HENRY A. WALLACE.
Under Secretary	M. L. WILSON.
Assistant Secretary	HARRY L. BROWN.
Director of Extension Work	C. W. WARBURTON.
Director of Finance	W. A. JUMP.
Director of Information	M. S. EISENHOWER.
Director of Personnel	W. W. STOCKBERGER.
Director of Research	JAMES T. JARDINE.
Solicitor	MASTIN G. WHITE.
Agricultural Adjustment Administration	H. R. TOLLEY, *Administrator.*
Bureau of Agricultural Economics	A. G. BLACK, *Chief.*
Bureau of Agricultural Engineering	S. H. MCCRORY, *Chief.*
Bureau of Animal Industry	JOHN T. MOHLER, *Chief.*
Bureau of Biological Survey	IRA N. GABRIELSON, *Chief.*
Bureau of Chemistry and Soils	HENRY G. KNIGHT, *Chief.*
Commodity Exchange Administration	J. W. T. DUVEL, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Entomology and Plant Quarantine	LEE A. STRONG, *Chief.*
Office of Experiment Stations	JAMES T. JARDINE, *Chief.*
Farm Security Administration	W. W. ALEXANDER, *Administrator.*
Food and Drug Administration	WALTER G. CAMPBELL, *Chief.*
Forest Service	FERDINAND A. SILCOX, *Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*
Bureau of Plant Industry	FREDERICK D. RICHEY, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Soil Conservation Service	H. H. BENNETT, *Chief.*
Weather Bureau	WILLIS R. GREGG, *Chief.*

U. S. GOVERNMENT PRINTING OFFICE: 1938

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - Price 5 cents